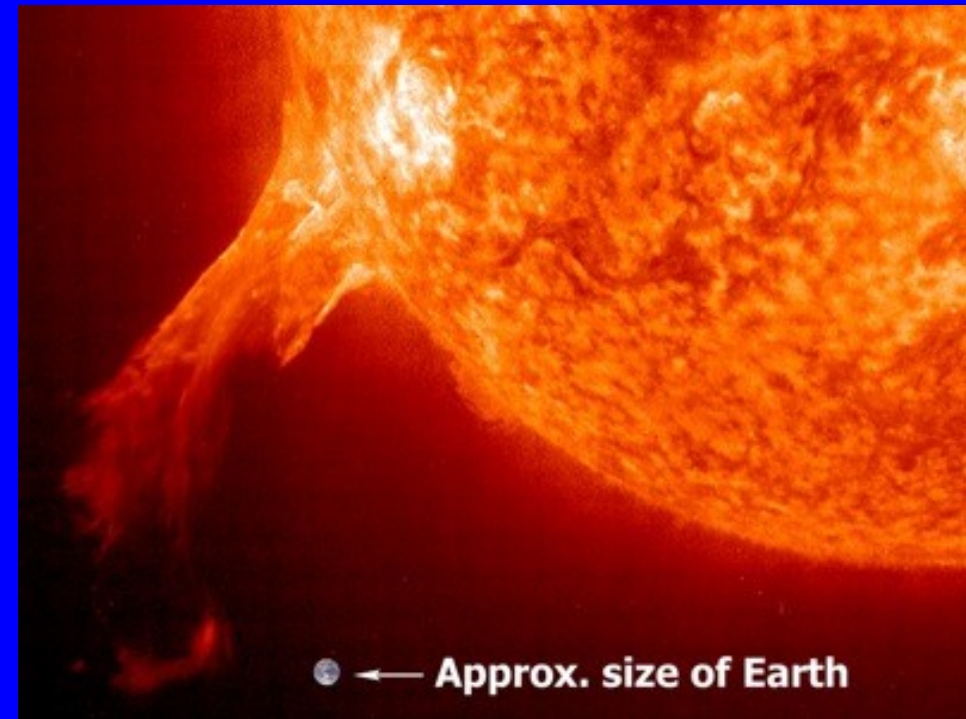
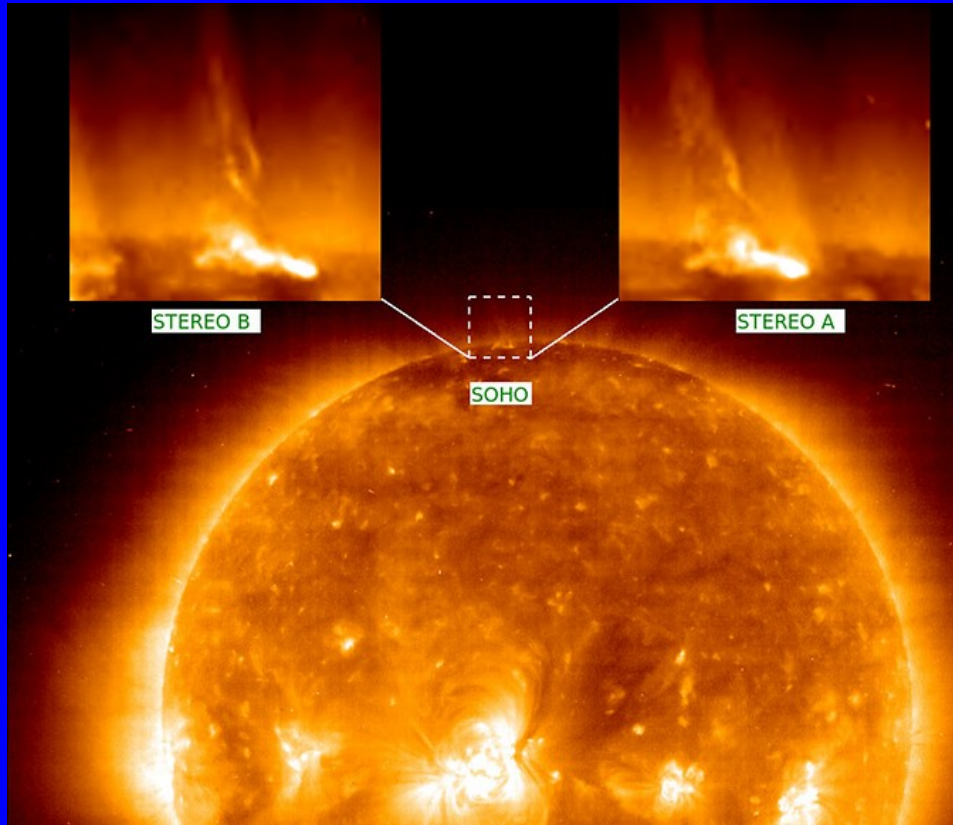
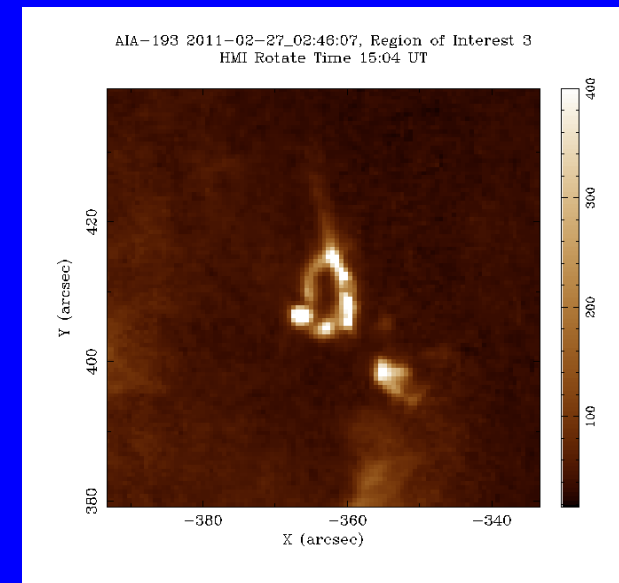


# Jets and the Many Scales of Solar Phenomena



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# We Will Discuss --

What is a Jet?	Astrophysical, Solar, Why are Jets important?
Layers of the Sun	Interior Atmosphere
Surface Features	Sunspots and Magnetic Fields Granulation
Filaments	
Spicules	
Solar Cycle	Sunspots Coronal Holes Bright Points
Jets in Coronal Holes	Polar Low Latitude
Summary	Some Answers to Why are Jets Important

# What is a Jet?



**JET** / noun – plural noun: jets

1. a rapid stream of liquid or gas forced out of a small opening."a high-pressure shower with pulsating jets", a nozzle or narrow opening for sending out a jet of liquid or gas."Agnes turned up the gas jet"
2. an aircraft powered by one or more jet engines."a private jet", "Astronauts fly T-38 jets."

# Jets in the Astrophysical Sense

Relativistic  
Jet

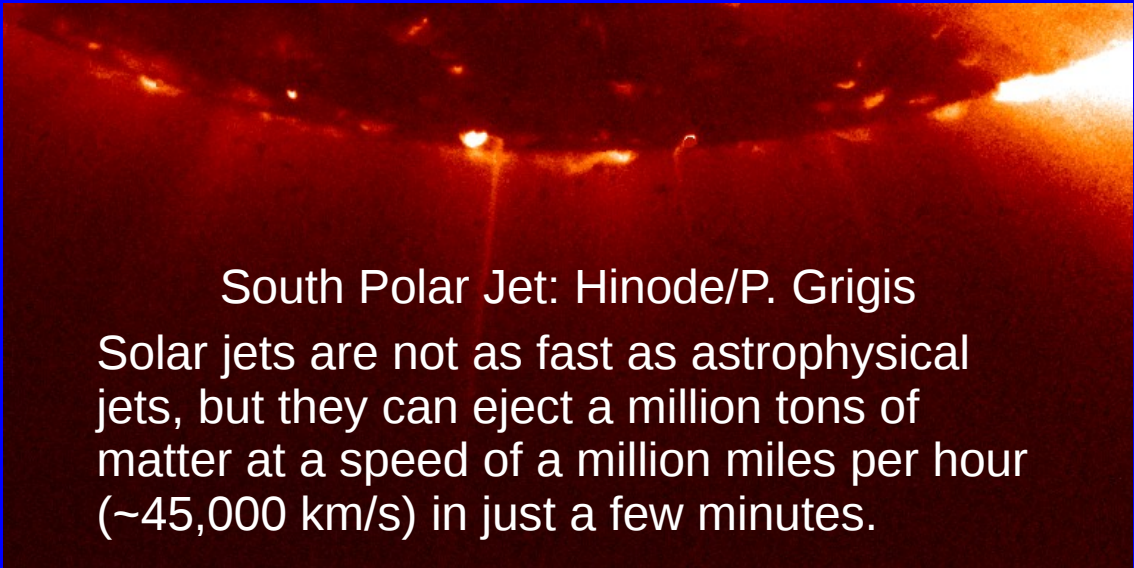


Slower jets, of order 100s km/s originate from young accreting stars, with lengths  $\sim 1$  pc (3.26 ly)

Centaurus A: From the Chandra X-ray Observatory's Archives, duration of “exposure” is over 9.5 days (Dec 1999-Aug 2012). Red, green, and blue show low, medium, and high-energy X rays, respectively.

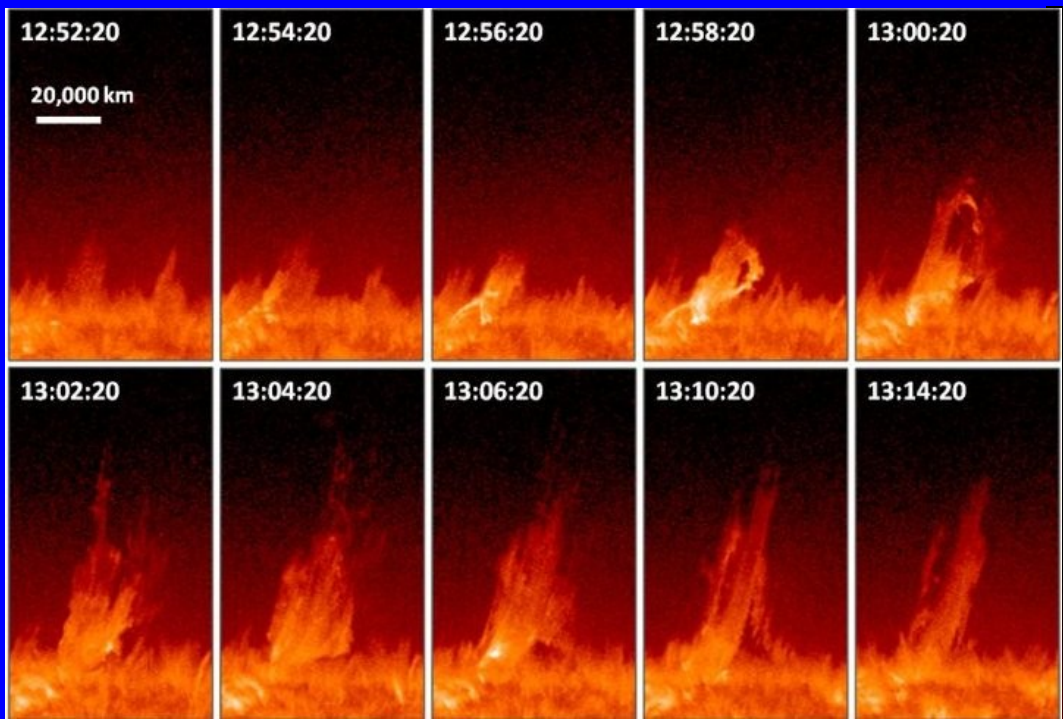
Cen A is a galaxy 12 million ly from Earth. The jet is generated from a massive black hole at galaxy center and extends about 13,000 ly away from the black hole. The jet is relativistic, moving at  $0.5c$ .





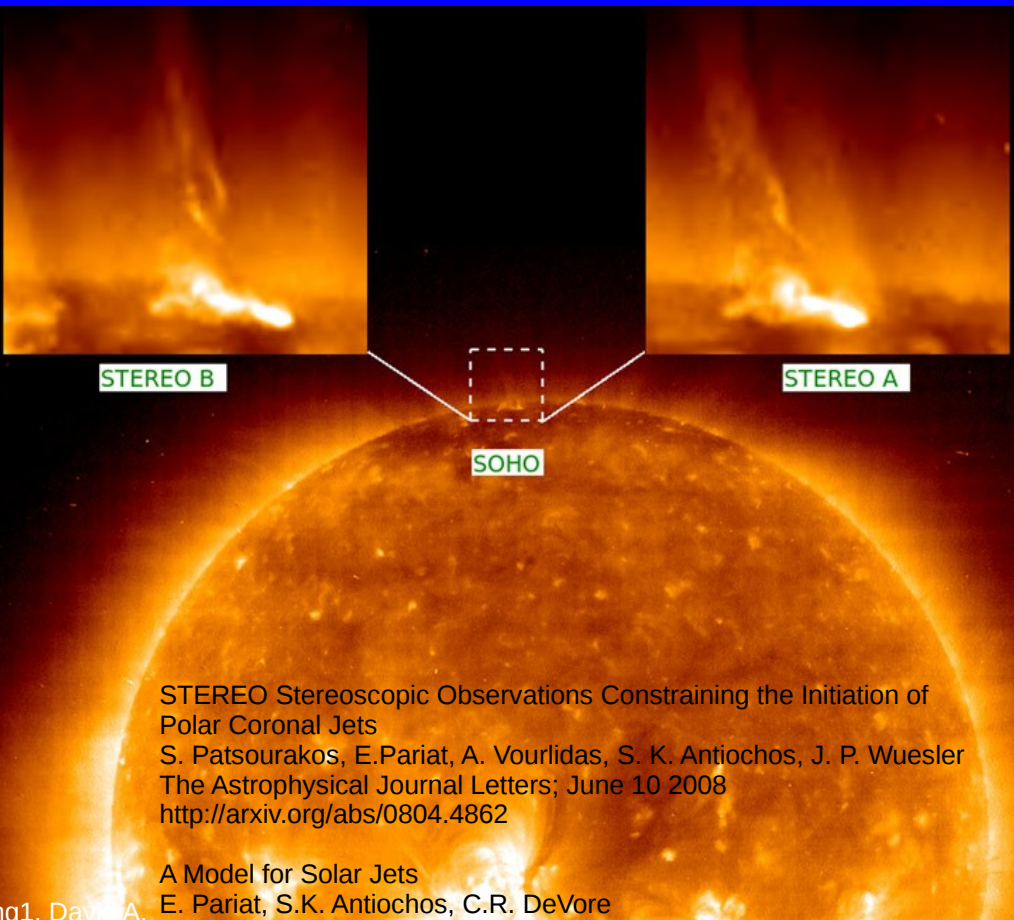
South Polar Jet: Hinode/P. Grigis

Solar jets are not as fast as astrophysical jets, but they can eject a million tons of matter at a speed of a million miles per hour (~45,000 km/s) in just a few minutes.



Above is an example of a “blowout” jet, from a northern polar coronal hole on 2010 October 2. The images are from SDO's AIA in 304 Å.

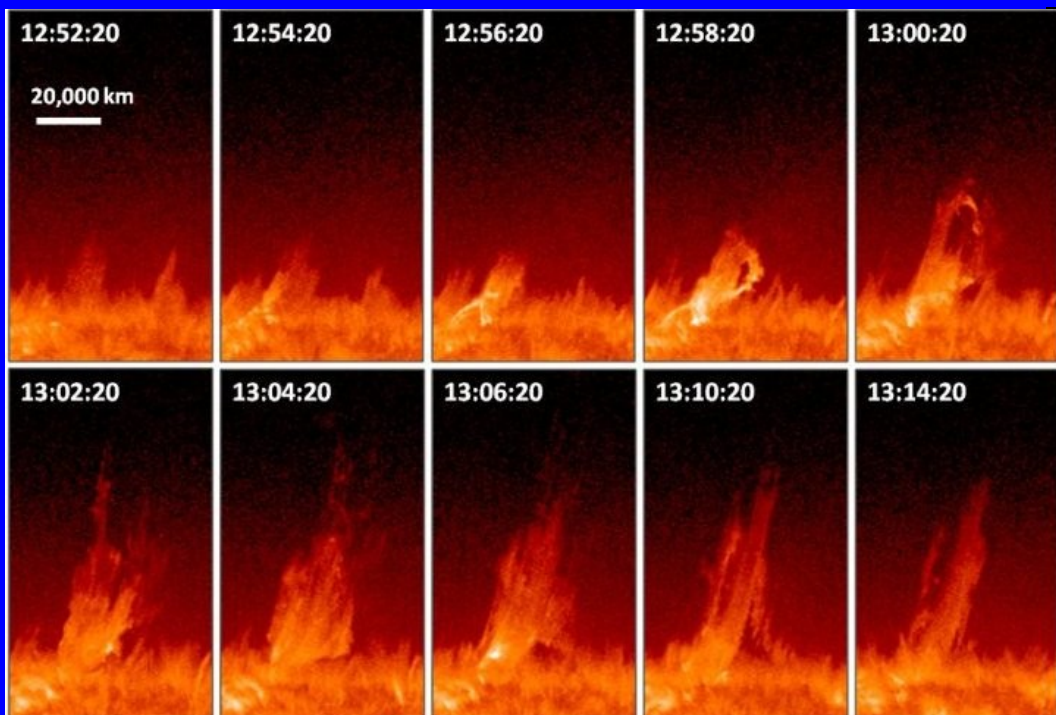
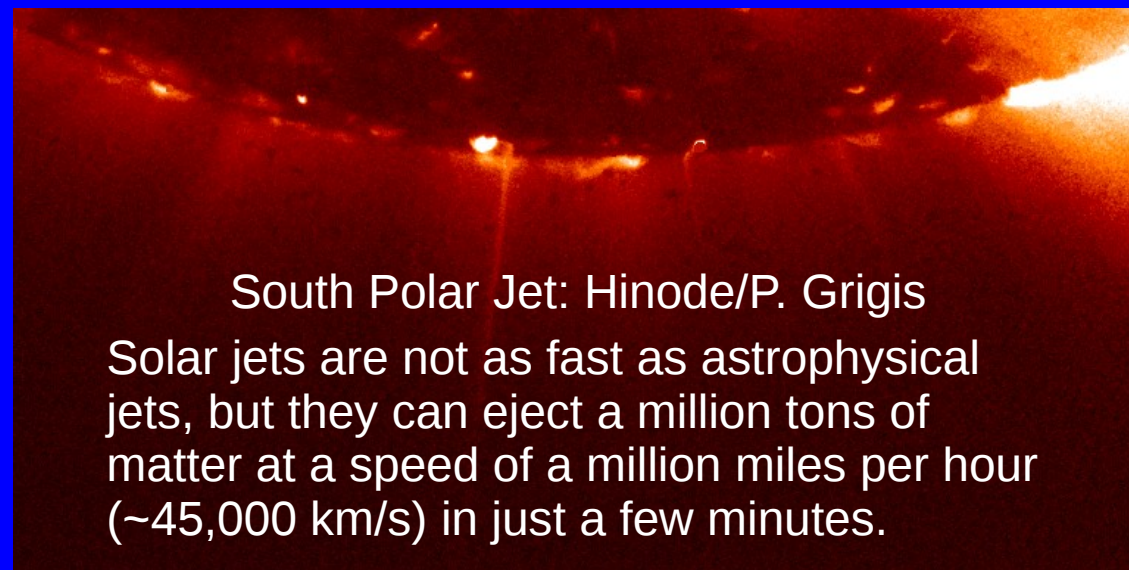
ORIGIN AND AXIAL ROTATION OF SOLAR X-RAY JETS: R.L. Moore, et al. ApJ, 768:134 2013 June 1



STEREO Stereoscopic Observations Constraining the Initiation of Polar Coronal Jets  
S. Patsourakos, E. Pariat, A. Vourlidas, S. K. Antiochos, J. P. Wuesler  
The Astrophysical Journal Letters; June 10 2008  
<http://arxiv.org/abs/0804.4862>

A Model for Solar Jets  
E. Pariat, S.K. Antiochos, C.R. DeVore





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From: The Cool Component and the Dichotomy, Lateral Expansion, and Axial Rotation of Solar X-Ray Jets, R.L. Moore, *et al.*, **ApJ**, 768:134 2013 June 1

